

FUSES, MOUNTINGS, AND ENCLOSURES

REQUIREMENTS AND ADJUSTING PROCEDURES

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1. GENERAL		
1.01 This section covers requirements and adjusting procedures for the following fuses (including link-type and plug-type), fuse mountings, and enclosures for use in telephone power plants:		
KS-5040 (Mfr Disc.) KS-5040-01 (Mfr Disc.)		
1.02 Revision arrows are used to emphasize significant changes. The Equipment Test List is not		

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NOTICE

Not for use or disclosure outside the
Bell System except under written agreement

affected. The reason for reissuing this section is to add information on link-type fuses.

1.03 DANGER: Extreme care must be taken when working on or near equipment with high current capability and/or when high voltage is present. To prevent bodily injury, bracelets, rings, key chains, wrist watches, metal belts, and buckles should not be worn while inspecting or maintaining electrical equipment. Insulated tools (see Section 074-000-001), gloves, and mats should be used at all times. However, it is not necessary to use an insulated mat when working on dc distributing boards which do not exceed 135 volts.

1.04 DANGER: For link-type fuses, covers are to be left in place when no service is being performed. A fuse upon failing, particularly the link-type where the fuse metal is unprotected, usually becomes molten metal instantly and, if spattered, may cause serious injury to a person nearby.

1.05 DANGER: When it is not possible to remove potential from the fuse, clips, or current-carrying connections of high-voltage/current circuits, the adjacent clips or connections of opposite polarity shall be wrapped with canvas or friction tape to prevent accidental contact which might result in a short circuit or injury to the person. Terminals that are spring loaded and must be free to move to generate contact pressure (terminals such as the load terminals on fuse block KS-14169) should not be taped. The contact that is made through the moveable terminal may be broken during the application or removal of the tape causing a service interruption. (See Fig. 1 for terminal identification.)

1.06 DANGER: Uninsulated metal tools, such as pliers, screwdrivers, and wrenches used for working on or near high-voltage/current circuits, should be insulated with three wrappings of friction tape, each wrapping applied with a half lap. If access to a nut or bolt is difficult and safety conditions warrant, the use of a box-end wrench may be advisable.

1.07 DANGER: When using petroleum spirits for cleaning purposes in the power

room, provide as much ventilation as practicable. After using the petroleum spirits, the commutators of all dc machines in the power room should be burnished, in accordance with approved procedures for the machines involved, since the fumes from the petroleum spirits may soften commutator film and thus adversely affect commutation.

1.08 Caution: It is recommended that work on live equipment be performed during periods of light traffic. Each exception, including the temperature test of discharge fuses or removal of defective fuses, should be discussed with the supervisor before work is started since the removal of even an apparently minor fuse may result in a service interruption.

1.09 The following Bell System Practices are referenced within this section:

SECTION	TITLE
026-370-801	Fuse Caps, Blocks, Clips, Holders, Mountings, Panels, and Posts—Repair and Replacement Procedures
026-371-501	Inspection of Fuses and Fuse Panels
030-740-701	Knife Switches—Requirements and Adjusting Procedures
074-000-001	Index of Tools—Switching System and Power
171-115-501	Checking Load on Individual Leads.
1.10	For apparatus requirements and adjusting procedures for knife switches KS-5040, KS-5040-01, KS-5040-02, and KS-5047 (Mfr Disc.), see Section 030-740-701.
1.11	National electrical code fuses as covered herein are of two general types, those for mounting in ferrule-type clips and those for mounting in knife switch-type clips.
1.12	A fuse puller should be used when removing and inserting cartridge-type fuses in spring

clip mountings to assure all possible safety protection in case trouble remains on the circuit being energized.

1.13 When possible, service shall be disconnected before working on fuses, fuse clips, blades, or current-carrying connections.

1.14 If service must be maintained, no fuse shall be removed without first making provision for the maintenance of service. In some instances, such as battery distribution panels, duplicate fuses are provided and the working fuse shall be replaced (by operating the switch) with a spare fuse before removal.

1.15 A defective fuse should not be removed until a spare fuse is available and the fuse can be replaced as soon as possible, unless service is maintained by some alternative method.

1.16 Main fuses in the input power circuits of an office are usually maintained by employees of the power company. The maintenance of these fuses is not included in this section.

1.17 The current-carrying capacity of a fuse may be reduced considerably with age. Older fuses may open at normal current levels and interrupt service. Local supervisors may wish to authorize the replacement of fuses that have been in service 15 to 20 years. The probable performance of a fuse cannot be reliably predicated from service records or resistance measurements on the fuses. Fuses and fuse panels may be inspected as covered in Section 026-371-501. Refer to Section 171-115-501 on methods of checking the load on fuses in service.

1.18 Unless otherwise stated, the requirements in this section shall be gauged by feel.

1.19 ♦**Index:** Table A indicates the paragraph numbers for requirements and adjusting procedures corresponding to each topic.♦

TABLE A

INDEX

PART	REQUIREMENTS	ADJUSTING PROCEDURE
Current-Carrying Connection	3.01	4.01
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SAFTOFUSE Unit	3.08	—

2. APPARATUS

2.01 **List of Tools, Gauges, Materials, and Test Apparatus:** The following tools, gauges, materials, and test apparatus should be available for use in making the repairs and adjustments described in this section.

TOOLS	DESCRIPTION
R-1255	31/32-Inch and 1-1/16 Inch Open Double-End Flat Wrench
R-1289	1-5/8 Inch Open Single-End Flat Wrench
R-1770	1/2-Inch and 9/16-Inch Open Double-End Flat Wrench
R-2512	Adjustable Wrench
R-2593	7/8-Inch and 1-1/16 Inch Open Double-End Flat Wrench
R-60622	2-Inch Open Single-End Flat Wrench
R-60623	2-3/8 Inch Open Single-End Flat Wrench
KS-6015	Duck-Bill Pliers
KS-6367	7/16-Inch and 5/8-Inch Open Double-End Flat Wrench

SECTION 026-370-701

TOOLS	DESCRIPTION
TP-87697	1/2-Inch and 3/4-Inch Open Double-End Flat Wrench
—	11/16-Inch and 25/32-Inch Open Double-End Flat Wrench
—	15/16-Inch and 1-Inch Open Double-End Flat Wrench
—	1-7/16 Inch and 1-13/16 Inch Open Double-End Flat Wrench
—	Wrench, Adjustable, Billings and Spencer No. 9, Model G
34-002	Fuse Puller, 7-1/2 Inches, Ideal Industries, Inc (or equivalent)
34-003	Fuse Puller, 12 Inches, Ideal Industries, Inc
—	3-Inch Cabinet Screwdriver
—	4-Inch Regular Screwdriver
—	5-Inch Regular Screwdriver
—	268 Tool Kit
—	◆B-Torque Wrench◆

GAUGES

R-1032	Thermometer (Detail 1)
KS-6909	Thickness Gauge Nest

MATERIALS

R-3266	NO-OX-ID* "A" Compound
KS-7860	Petroleum Spirits
KS-14666	Cleaning Cloth
KS-20406	Trichlorotrifluoroethane Spray Cleaner
—	Canvas or Tape
—	Abrasive Cloth, 100 Grade
—	3-Inch Cotton Bandage

* Trademark of Sanchem, Inc.

TOOLS	DESCRIPTION
—	Felt Pad
—	10-Inch by 1-3/4 Inch by 1/16-Inch Fiber Board
—	4/0 Sandpaper

TEST APPARATUS

KS-14510, L1	Volt-Ohm-Milliammeter
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3. REQUIREMENTS

3.01 Current-Carrying Connections: To check current-carrying connections for tightness and cleanness, proceed as follows:

- Current-carrying connections shall be inspected periodically for tightness and freedom from corrosion.
- Current-carrying connections that cannot be tightened properly shall be soldered in place where feasible.

3.02 Fuse Mountings: To check fuse mountings for tightness, proceed as follows:

- All assembly screws and nuts shall be tightened firmly.
- Fuse clips shall be held securely to their associated panel, fuse box, or mounting assembly.
- Fuses shall be aligned and held securely in their fuse clips.

3.03 Clips and Blades: To check the clips and blades, proceed as follows:

- Clips and blades shall be clean, smooth, and free from rough edges.
- Knife blade-type clips shall be slightly converging, that is, slightly closer at the lip where the blade enters.
- Ferrule-type clips shall have the approximate curvature of the cartridge-type fuse cap and

shall spring noticeably as the fuse is placed in position.

- (d) The contact surfaces of all fuses, clips, and blades shall be wiped with a thin film of NO-OX-ID "A" compound when installing the fuse, and periodically thereafter as determined by local conditions. The amount of NO-OX-ID "A" compound used shall not be excessive.

3.04 Contact Area: To check the contact area, proceed as follows:

Note: This requirement need not be checked during maintenance unless the apparatus or part is made accessible for other reasons or the performance indicates that such a check is advisable.

- (a) Fuses having ferrule-type clips shall have a reasonably tight fit in the clip sufficient to carry the current required for the particular installation without excessive heating.
- (b) Fuses having knife blade-type clips shall require a 0.0015-inch thickness gauge around at least 50 percent of the accessible outer junction line, for 30- to 60-ampere sizes and 90 percent for 100-ampere and over sizes. Use KS-6909 gauge.
- (c) The head blades and the body clips of SAFTOFUSE units shown in Fig. 1, or other arrangements where contact area cannot be checked readily, have no contact area requirement, but shall have a reasonably tight fit sufficient to carry the current for the particular installation without excessive heating.
- (d) If any question arises as to whether the fuse meets the contact area requirements, the temperature requirements shall determine the acceptability of the fuse provided the other requirements of this section are met.

3.05 Temperature; Caution: Interruption of service may be caused by dirty contacts. Dirty contacts may also cause overheating of the fuse and annealing of the metal in the fuse clip and result in the loss of pressure on the clips. The maximum acceptable temperature rise above ambient for the fuse clips or blades, when the fuse is carrying rated current, is shown in Table B.4

Note: This requirement need not be checked by the installer unless it is thought the require-

ment is not being met or the performance indicates that such a check is advisable.

3.06 Link-Type Fuses: Link-type fuses, found in some older offices, should be examined periodically to see that their mounting studs and nuts or screws are firm and their contact surfaces are clean. The fuses should also be examined for proper rating.

Note: Over a period of time the fuse retaining nuts may loosen and should be tightened.

3.07 Plug-Type Fuses: Plug-type fuses should be examined periodically to see that they are firm in their sockets, that the sockets are clean, and that all connections are tight.

3.08 SAFTOFUSE units are provided with fuse test holes as shown in Fig. 1. This permits testing of the fuse, without removing the head, by connecting the lead to the line and inserting the test picks of a KS-14510, L1, volt-ohm-milliammeter through the dead front or head and into the test fuse holes. A full-rated voltage reading indicates the fuse is open. A continuity reading indicates the fuse is good.

4. ADJUSTING PROCEDURES

4.01 Current-Carrying Connections: To tighten and clean current carrying connections, proceed as follows:

- (1) If screws or nuts of current connections are loose, tighten them with a suitable taped or insulated screwdriver or wrench. Where corrosion is present, clean the affected parts with a cloth moistened with petroleum spirits and wipe dry. Heavy corrosion should be removed with sandpaper and all loose particles removed with a clean cloth. Copper contacts should be cleaned with KS-16736, L1, compound. After cleaning, place a small amount of NO-OX-ID "A" compound on a clean cloth and apply a thin film over the entire area. Where it is impossible to remove the corrosion, the affected parts should be replaced.
- (2) Any current connection that cannot be tightened properly should be soldered. The flux used for making these soldered connections should be of the neutral-alcohol type, or equivalent, and not of the acid type.

4.02 Fuse Mountings: Warning: When adding or removing SAFTOFUSE bodies or

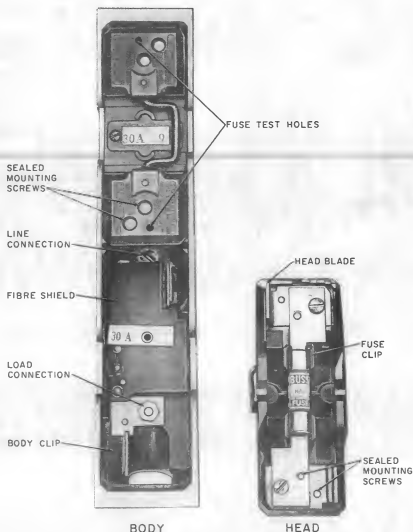


Fig. 1—30-Ampere SAFTOFUSE Unit—Assembly Details

when tightening body-mounting screws, the bus bars should be disconnected from power to avoid causing shorts with the screwdriver. To insure that fuse mountings are tight, proceed as follows:

- (1) Loose assembly screws or nuts should be tightened, where access is possible, with a taped or insulated screwdriver or wrench of suitable size.
- (2) When fuse clips are found loose on the panel, fuse box, or mounting, tighten the holding nuts or screws with a suitable taped or insulated screwdriver or wrench if ready access can be obtained. While tightening the screws or nuts, be sure that the center lines of the fuse clips at both ends of the fuse remain in the same plane. An old or used fuse inserted in the clips will aid in the aligning process. In some instances, it may be possible to solder permanently [see subparagraph 4.01(2)] those screws that do not stay secure when tightened.
- (3) Some mounting screws, such as those in SAFTOFUSE units, are embedded in countersunk holes in the fuse unit head or body and covered with a sealing compound. Before attempting to remove the compound to tighten these

TABLE B

TEMPERATURE AND CURRENT REQUIREMENTS

MAXIMUM TEMPERATURE RISE ABOVE AMBIENT	FUSE RATING IN AMPERES
50°C (90°F)	0-100
60°C (108°F)	101-200
65°C (117°F)	201-400
75°C (135°F)	401-600

screws, the matter should be referred to the supervisor.

Note: Unequipped panels have a metal space cover (apparatus blank) with a fiber block to keep the cover from shorting on the bus. Discard this cover when the space is equipped.

4.03 Clips and Blades: To insure that the clips and blades are clean, proceed as follows:

(1) To clean the clips and blades, wipe their accessible contact surfaces with a clean cloth either dry or moistened with petroleum spirits, applying sufficient pressure to remove all dirt and lubricant. Rough copper contact surfaces may be smoothed with abrasive cloth or a fine file until the blades, clips, or caps (ferrule type) engage smoothly. To avoid shortening the life of the clips or blades, remove only a minimum amount of copper. After smoothing, remove all loose particles of copper by wiping the surfaces thoroughly with a clean, dry cloth. The body clips and head blades of SAFTOFUSE units and the blades of KS-15763 fuses and associated fuse blocks have silver surfaces; and if smoothing is required, remove only the absolute minimum of the silver surface.

(2) Clips for knife blade-type fuses may be checked and adjusted as covered in Section 030-740-701 covering knife switches.

Note: If blade-type fuse clips are equipped with a cotter pin, or equivalent, to prevent removal of the fuse, discard the cotter pin, or equivalent.

(3) Clips of ferrule-type fuses may be shaped with duck-bill pliers to the curvature of the associated cartridge-type fuse cap.

Note: Temporary repair usually can be made by squeezing the clip to increase pressure.

(4) **Caution:** Avoid an excess of compound, as it will collect dust and dirt. If too little compound is used, the contacting surfaces will soon tarnish, which will cause heating of the fuse and fuse clips. If the contact is not clean, it may cause the fuse to overheat, causing annealing of the metal in the fuse clip and may result in the loss of pressure. With a small amount of NO-OX-ID "A" compound on a clean, dry cloth, apply a thin film of the compound to the contacting surfaces of the fuses, clips, or blades. Do not apply compound to other parts of the fuses or clip assembly.

4.04 Contact Area: To adjust the contact area, proceed as follows:

Note: This procedure need not be checked during maintenance unless the apparatus or part is made accessible for other reasons or performance indicates that such a check is advisable.

(1) The clips of ferrule-type fuses should be so adjusted, with duck-bill pliers, that appreciable pressure is necessary to insert the fuse in the clips. Once within the clips, contact should be sufficient to hold the fuse firmly in place so that heating of the fuse or clips due to contact resistance may be prevented. Phosphor-bronze, ferrule-type clips sometimes fail to maintain satisfactory contact. In such instances, these clips should be removed and replaced with copper clips having steel reinforcing springs. The copper clips with steel springs may be obtained by specifying, for example, "two Gould fuse clips, Catalog No. 2221." Each fuse requires two clips and the example given is good for any size fuse up to and including 30-ampere capacity.

(2) To check the contact area of fuses having knife blade-type clips, see that the blades rest fully within the clips and that they are in the same plane. Attempt to insert the thickness gauge between the blades and clips at all accessible points along the outer junction line. If the requirement is not met, readjust as covered in Section 030-740-701.

(3) **Caution:** It is recommended that work on live equipment be performed during

periods of light traffic. Each exception, including the temperature test of discharge fuses, removal of defective fuses, adjustments, or dismantling, should be discussed with the supervisor before work is started since the removal of even an apparently minor fuse may result in a service interruption. Some of the head blades and body clips of SAFTOFUSE unit (Fig. 2) cannot be adjusted without dismantling the unit.

(4) Where there is copper-to-copper contact between fuses and fuse clips, all fuses and fuse clips, unless silver plated, should have their contact surfaces cleaned by one of the following procedures to remove any oxide present.

(a) Prepare several paddles by wrapping several layers of 3-inch cotton bandage around a fiber board approximately 10 inches long, 1-3/4 inches wide and 1/16-inch thick. Tie the

bandage to the paddle with a cord at each end and at the middle of the bandage.

(b) Moisten the bandage on one of the paddles with KS-20406 cleaner and wipe all accessible contact surfaces clean, removing any accumulated dirt and old lubricant.

(c) After a 1/2-hour interval, remove all compound possible using a clean, dry paddle. Then finish with a paddle moistened with KS-20406 cleaner. Change the paddle when dirty and continue cleaning until all the compound is removed from the contact surfaces.

(d) An alternate cleaning procedure is to clean contact surfaces with fine sandpaper after using petroleum spirits to remove dirt, etc. Then finish by removing abrasive particles with a paddle saturated with petroleum spirits.

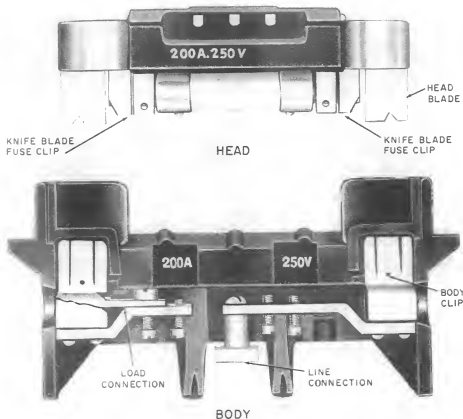


Fig. 2—200-Ampere SAFTOFUSE Unit—Sectional View

- (e) After either cleaning procedure, apply a light film of NO-OX-ID "A" compound.

4.05 Temperature: Caution: *It is recommended that work on live equipment be performed during periods of light traffic. Each exception, including the temperature test of discharge fuses or removal of defective fuses, should be discussed with the supervisor before work is started since the removal of even an apparently minor fuse may result in a service interruption.* To adjust temperature, proceed as follows:

Note: This procedure need not be performed unless it is suspected that the temperature is out of limits or performance indicates that such a check is advisable.

- (1) The temperature of any part may be measured by placing the bulb of the thermometer on the part, the temperature of which is desired, covering the exposed portion of the bulb with a piece of felt, and observing the highest temperature reading. In SAFTOFUSE units, it will be necessary to remove

the fuse unit head and the temperature should be taken immediately upon removal.

- (2) If the temperature exceeds the specified limits, refer the matter to the supervisor.
- (3) Any clips showing signs of having been overheated (blue or burned) should be replaced in accordance with ¶Section 026-370-801.¶

¶4.06 Link-Type Fuses: Warning: *The KS-19392, L12 through L16 [UBL-type fuses (Mfr Disc. and UBO-type)] must be kept from turning when tightening the holding nuts. This will prevent stress and fracture of the fusible links (Fig. 3).* The clamping nuts holding the KS-19392, L12 through L16 [UBL- (Mfr Disc.) or UBO-type] link-type fuses into the fuse panel, should be torqued to 190 inch-pounds using the B-torque wrench. This will sufficiently tighten the link-fuse.

Note: A simple phenolic spacer applied temporarily between the fuse panel and the fuse-link (Fig. 4), while torquing, is adequate to block the fusible link and prevent fracture.¶

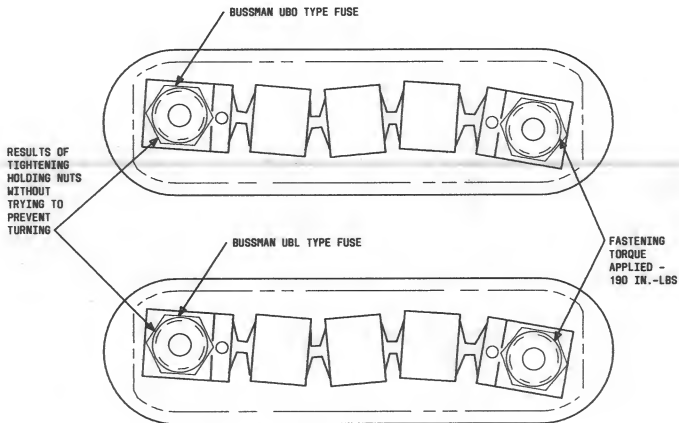
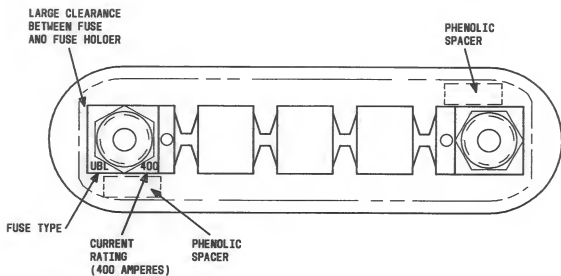
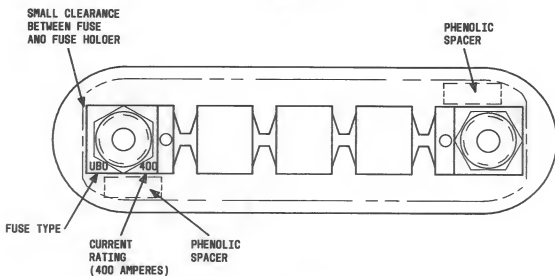


Fig. 3—Link Fuse Holders for KS-19392 Fuse and Switch Panels and KS-19393 Fuse Blocks (Fuse Holding Nuts in Place and Tighten)¶



UBL-TYPE



UBO-TYPE

Fig. 4— Φ KS-19392, L12 Through L16 (UBL- and UBO-Type Link Fuse) Blocking Point Φ

